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A study on the effect of biotic and abiotic factors on the biology of *Osteobrama belangeri* (Pengba) in Manipur State

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***Abstract** :* *Osteobrama belangeri* the State fish of Manipur and locally called "Pengba", is a minor carp and endemic to Manipur of Northeast India. However, its population has declined significantly over the last few decades and the species is currently listed among the endangered fish species of India and classified as 'extinct in the wild' (CAMP reports, 1998). The abundance of the species declined due to habitat degradation, construction of dam and other biotic as well as abiotic factors. Because of its high consumer preference, in taste, price and demand *O. belangeri* fetches better price than the fish species in domestic markets in Manipur. In order to produce more quantity of this fish farmers started to use different techniques such as hormonal inducement, pen culture fish farming technique, cage system farming etc. The present study aims to find out the effect of abiotic and biotic factors on the developmental biology of *Osteobrama belangeri* (Pengba) in the State Manipur.

***Index Terms - Osteobrama belangeri,* biology, Manipur, breeding ,fishing.**

I. INTRODUCTION

Manipur is border state of India, which is bounded by Nagaland on the north, Mizoram on the south, Myanmar on the east, and Assam on the west. This cup-shaped land has a series of hill ranges. It shares a 352 km long international border line with Myanmar. The climate of Manipur is largely influenced by the topography of this hilly region. Situated at an elevation of 790 meters above the sea level, the state of Manipur is wedged between hills from all sides. This north eastern corner of India is blessed with a generally amiable climate though the winters can be a little chilly. The temperature, throughout the year, is comfortable ranging from a minimum temperature of 0°C to 10°C and a maximum temperature of 22.5°C to 43°C. It receives an average rainfall of 1467.5mm, annually. Fish is the main food item of the majority of the people in the state leading to the demand for fish increasing over time with the increase in purchasing power and standard of living. Fish culture has become a popular enterprise in the state but the production level has not met the demand for a very long period. So, it is important to identify the barriers which are working behind the growth and development of fish farmers in the State. This study was undertaken to identify the impact of biotic and the abiotic factors on the study of biology of Pengba fish. In Manipur state. *Osteobrama belangeri* (local name Pengba) is indigenous to the state of Manipur and it is declared as state fish by government of Manipur. *Osteobrama belangeri* is almost extinct in the wild and it fetches a very high market price in Manipur. Even though O. belangeri is a highly esteemed fish in Manipur, wide scale culture of the fish is yet to be seen. The major constraints are the scarcity of seeds and suitable feed for its culture. the Construction of dams, overfishing and other biotic as well as abiotic factors affects the breeding of the fish. Reports on the breeding of O. belangeri, there is no standardized breeding technique using new synthetic ovulating agents. Earlier breeding trials of this species were reported by Reddy (2000), Munilkumar and Nandeesha (2007) and Samarjit and Basudha (2007). It is an omnivore, feeding on aquatic insects, zooplankton, and detritus. It is a commercially important fish, but its populations have declined due to habitat loss and overfishing. The state fisheries department has reported to have bred this fish with fish pituitary gland extracts.

Fig.1. *Osteobrama belangeri(*Pengba*)*

II. Current status of Pengba

O. belangeri has high potential in the composite culture technology widely practiced in the region. In a pen culture demonstration carried out by ICAR-CIFRI at Takmu pat (Takmu Lake) of Manipur during the year 2012, Pengba was stocked in the pen along with Indian major carps and Chinese carps (Bhatacharjya et al., 2013). Pengba recorded good growth with a specific growth rate of 1.38 which was highest among the stocked fish. This could be attributed to the presence of macrophytes in the wetland, which formed the major food for the fish in addition to the pelleted feed provided. Breeding and culture of O. belangeri is gaining momentum in the state of Manipur (Yengkokpam, 2014). After the successful seed production technology developed, many private fish farmers have taken up culture of this indigenous fish in the state. However, the increasing trend in its production led to a drop in price from more than 1000 per kg a few years back to 400-800 per kg at present. Earlier the fish was fairly prevalent in the water bodies of Imphal valley. Many workers give various reasons for the disappearance of this species, like the construction of dams and barrages, river regulation, water pollution, introduction of exotic fish species such as common carp which competes for the same ecological niche (Menon, 1989), indiscriminate fishing, etc. This is undoubtedly the first species to get the status of 'Extinct in the wild' in Manipur (Das et al., 2020). Recently, many workers from different regions of India have attempted to introduce the fish, propagate and refine farming techniques (Das et al., 2016; Das et al., 2020).

III. Biology of *O. belangeri* (Pengba)

Pengba is a seasonal and riverine spawner and it normally spawns during the monsoon season (June-July).Sexual maturity is attained in 2+ years when it reaches a size of 200-250 g. Males mature earlier than females and peak breeding season has been found to be of short duration ie., the first week of July to the second week of August in the mid-hill condition. However, reproduction occurs in higher temperature conditions, with less precipitation, and a long duration of sunshine. Mature fish showed distinct sexual dimorphism as in males, the body is more elongated with no bulging of the abdomen. Alike major carps, Pengba also exhibited secondary sexual characteristics during the breeding season such as in males, the roughness of the pectoral fi ns whereas fully mature females exhibit bulging of the abdomen. , female fish are comparatively larger in the fully mature stage than their male counterparts. The relative fecundity has been recorded to be approximately 330,000 eggs kg-1 of body weight of a female brooder thus indicating that the fish is a prolific breeder. It breeds in riverine conditions during the southwest monsoon season however; it is not able to breed in confined waters.

Fig. 2. Eggs of *O. belangeri*

Fig. 3. Fry and fingerings

Fig. 4 Advance stage fingering

Fig. 5. Matured *O. belangeri*

IV. Facundity

The fecundity of *Osteobrama belangeri*, has been reported to range from 2089 to 26287 eggs, corresponding to body weights between 10.46 and 153.73 g. This means that larger individuals of this species can produce a significantly higher number of eggs. The relative fecundity, which is the number of eggs per gram of body weight, has been found to range from 170 to 298 eggs g^{-1}. This indicates that the reproductive potential of Osteobrama belangeri is quite high. It is important to note that these figures are based on limited studies and may vary depending on factors such as the age, size, and health of the individual fish, as well as environmental conditions. However, they provide a general idea of the reproductive capacity of this species.

V. Hatching Success

The hatching success of *Osteobrama belangeri* eggs has been reported to range from 60 to 90%, depending on factors such as water temperature, dissolved oxygen levels, and the presence of predators or pathogens. In one study, the hatching success of Osteobrama belangeri eggs was found to be highest at a water temperature of 28°C and a dissolved oxygen level of 6 mg/L. However, other studies have reported different optimal conditions for hatching success. It is important to note that hatching success can also be affected by factors such as the quality of the eggs, the age and health of the parents, and the presence of environmental pollutants. Overall, the fecundity and hatching success of Osteobrama belangeri are relatively high, which contributes to the species' ability to maintain healthy populations in the wild. However, it is important to monitor these parameters in both wild and captive populations to ensure the long-term sustainability of this species.

VI. CERTAIN FACTORS WHICH EFFECTS IN BIOLOGY OF PENGBA

Abiotic Factors:

Food Availability: Osteobrama belangeri is an omnivore, so a diverse food source is essential. This includes:

- **Natural Food:** Zooplankton, aquatic insects, detritus, and some plant matter.
- **Supplemental Feed:** Commercially available fish feed formulated for omnivores can be used to supplement natural food sources.

Water Quality:

- **Dissolved Oxygen (DO):** Adequate DO levels are crucial for fish health and growth. Aim for at least 5-6 ppm.
- **pH:** Maintain a slightly alkaline pH (7.0-8.0) for optimal growth.
- **Ammonia and Nitrite:** Keep ammonia and nitrite levels low to prevent stress and disease. Regular water changes and filtration are essential.

Water Temperature:

- Maintain a stable water temperature within the optimal range for Osteobrama belangeri (ideally between 22-28°C).
- Avoid sudden temperature fluctuations, which can stress the fish.

Water Depth:

- Provide adequate water depth to allow for swimming and comfortable movement.
- A minimum depth of 1.5-2 meters is generally recommended.

Light:

- Provide adequate natural or artificial light for photosynthesis by aquatic plants and to maintain a natural day-night cycle.

Water Flow:

- Some water flow is beneficial for oxygenation and to stimulate natural behavior.
- Avoid strong currents that may stress the fish.

Biotic factors

Predators:

- Protect the fish from predators such as larger fish, birds, and snakes.
- Use appropriate netting or barriers to prevent predation.

Diseases:

- Monitor fish health regularly for signs of disease.
- Consult with a veterinarian or fisheries specialist for diagnosis and treatment.
- Maintain good water quality and hygiene practices to minimize disease outbreaks.

Parasites:

- Regularly inspect fish for parasites.
- Consult with a veterinarian or fisheries specialist for appropriate treatment options.

Competition:

- Avoid overcrowding the pond to minimize competition for food and space.
- Consider poly culture with compatible species that do not compete directly with Osteobrama belangeri.

Osteobrama belangeri is an omnivorous fish, meaning it feeds on a variety of plant and animal matter.

- **Juveniles:** Primarily feed on zooplankton.
- **Adults:** Their diet shifts towards plant matter, with aquatic plants forming a significant portion. They also consume algae, insects, worms, and detritus.

VII. Result and Discussion

Understanding the impact of biotic and abiotic factors on their biology is crucial for conservation and management efforts many biotic factors such as larger fish species, as well as birds and aquatic mammals. Competition for food and space with other cyprinid species, parasites and diseases reducing its growth, reproductive output, and overall fitness. In the abiotic factors, *O. belangeri* is sensitive to changes in water quality parameters, such as dissolved oxygen, pH, and temperature. The availability of suitable habitats, including clear flowing waters with rocky substrates and aquatic vegetation, is crucial for *O. belangeri*. Habitat degradation due to pollution, deforestation, and dam construction can negatively impact its populations. Changes in river flow patterns, such as altered discharge and flow velocity, can affect food availability, spawning success, and overall habitat suitability for *O. belangeri*. The results highlight the complex interplay between biotic and abiotic factors in shaping the biology of *O. belangeri*. Understanding these interactions is essential for developing effective conservation strategies. Habitat restoration, pollution control, and the management of invasive species are crucial for mitigating the impact of these factors and ensuring the long-term survival of *O. belangeri*.

VIII. Conclusion

This study emphasize the critical role of both biotic and abiotic factors in shaping the biology of *O. belangeri*. By understanding these complex interactions, we can develop effective conservation and management strategies to protect these valuable resources.

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